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Integration of a Computable General Equilibrium Model with an Electricity Sector Optimization Model to Assess the Economic Impacts of U.S. Climate Policy

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Project Description

•**Thorough climate policy analysis** requires both a **broad, economy-wide scope** to capture economic effects, as well as **detailed analysis of the electric sector.** Models typically lack either scope or detail.

•**Economy-wide computable general equilibrium (CGE) models** are a standard tool to assess the economic costs of GHG mitigation policies, but typically lack the electricity-sector detail, especially with respect to renewable technologies.

•**Electric-sector-supply-side-only models** lack the ability to capture economy-wide effects, but have much more detail in the electric sector.

This project combines the strengths of both types of models by integrating a CGE (MIT's USREP) with an electric-sector-only model (NREL's ReEDS).

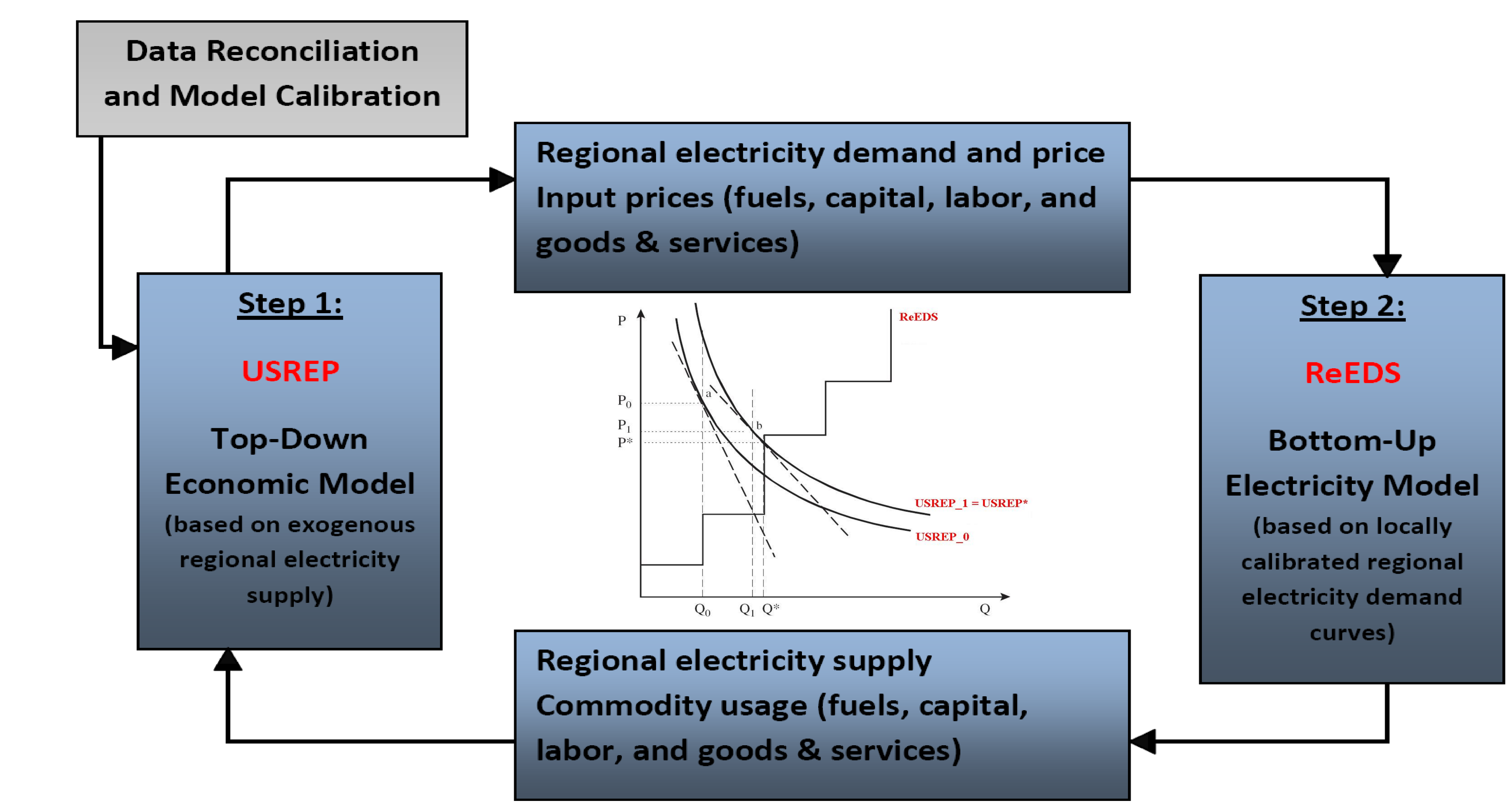

Figure 1. Overview of iterative steps and information exchanged between USREP and ReEDS.

Methodology for Coupling USREP and ReEDS Models

1 We use a **block decomposition algorithm** (Boehringer and Rutherford, 2009) involving an iterative procedure between both sub-models.

2 The **virtue of this approach** is to fully embed the ReEDS model within a general equilibrium setting.

3 Non-linear **electricity demand** from the CGE model is approximated with a regional demand function in ReEDS that is locally calibrated based on the solution of the CGE model.

4 Fuel prices, wages and capital rental rates from a candidate equilibrium solution from USREP are passed down to ReEDS model.

5 Regional electricity supplies and commodity usages from ReEDS are used to parameterize the USREP model.

6 Integrated assessment allows us to provide sound welfare estimates and enables us to assess the cost effectiveness of electric sector policies within an economy-wide context.

Figure 2. Regions in economic model.

Focus of Analysis

1 Examine the **efficiency and distributional implications of Clean Energy Standard (CES)** and Renewable Portfolio Standard (RES) in the U.S. electric power sector vis-à-vis a first-best permit market equilibrium (or a carbon tax).

2 Quantify both economy-wide and electric sector impacts

Results

1 The CES and RPS policies are about two and three times more costly than a cap-and-trade policy that achieves the same CO2 emissions reductions, respectively.

2 Welfare impacts of CES and RPS policies across income are regressive, i.e. they disproportionally hurt low-income households. "Cap-and-dividend" policy is progressive.

3 CES and RPS policies lead to smaller dispersion in regional welfare impacts.

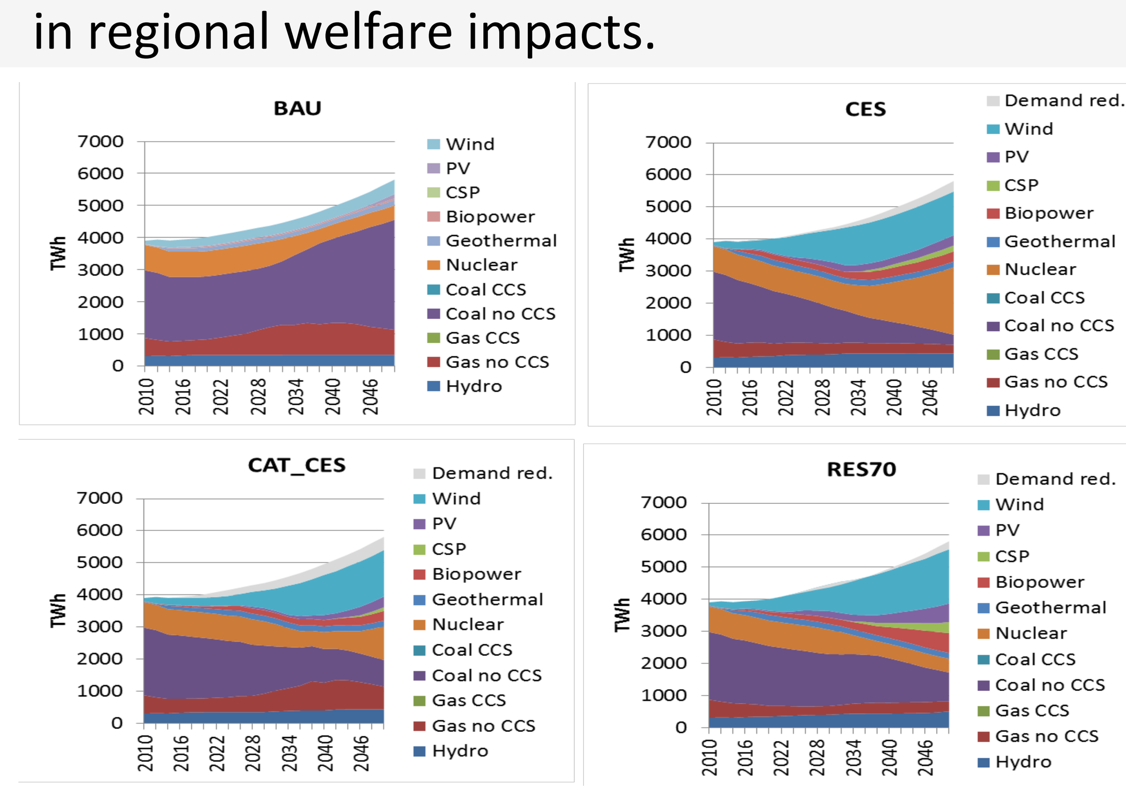

Figure 3. U.S. Electricity Generation.

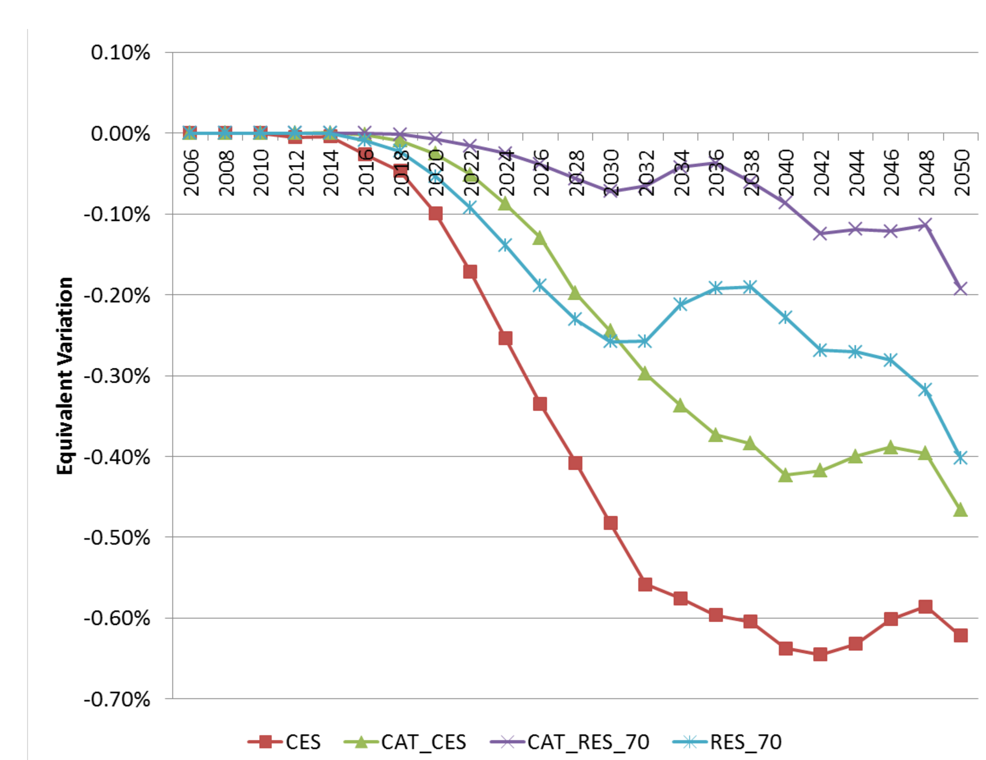

Figure 4. National welfare impacts.

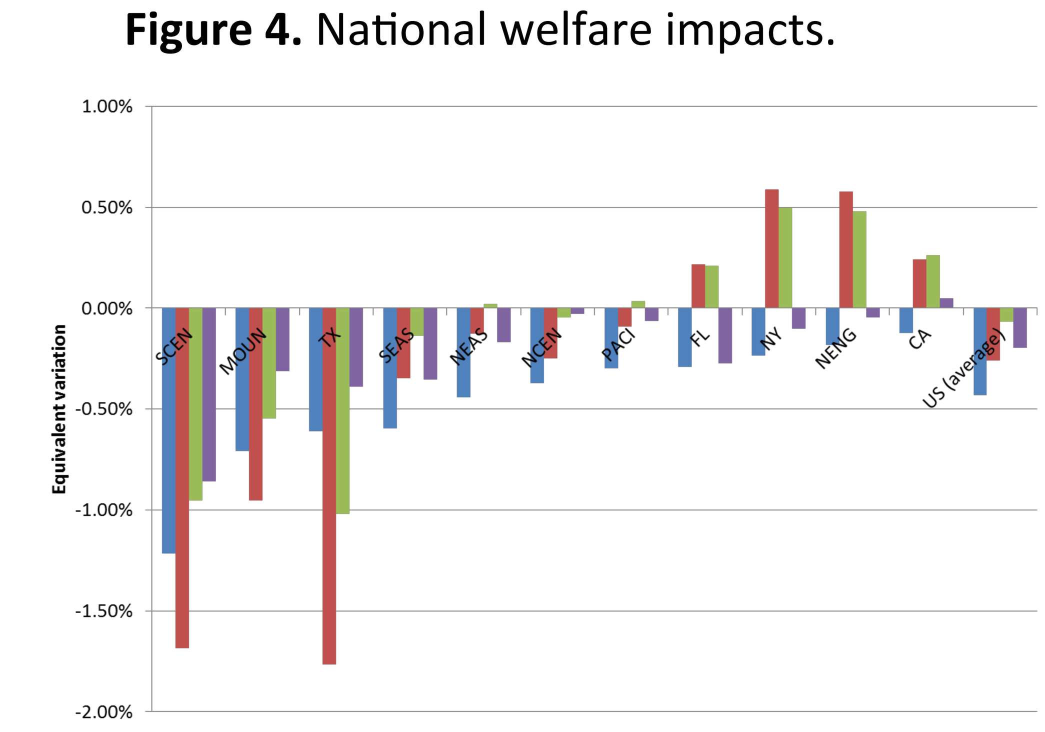

Figure 5. Welfare impacts by region.

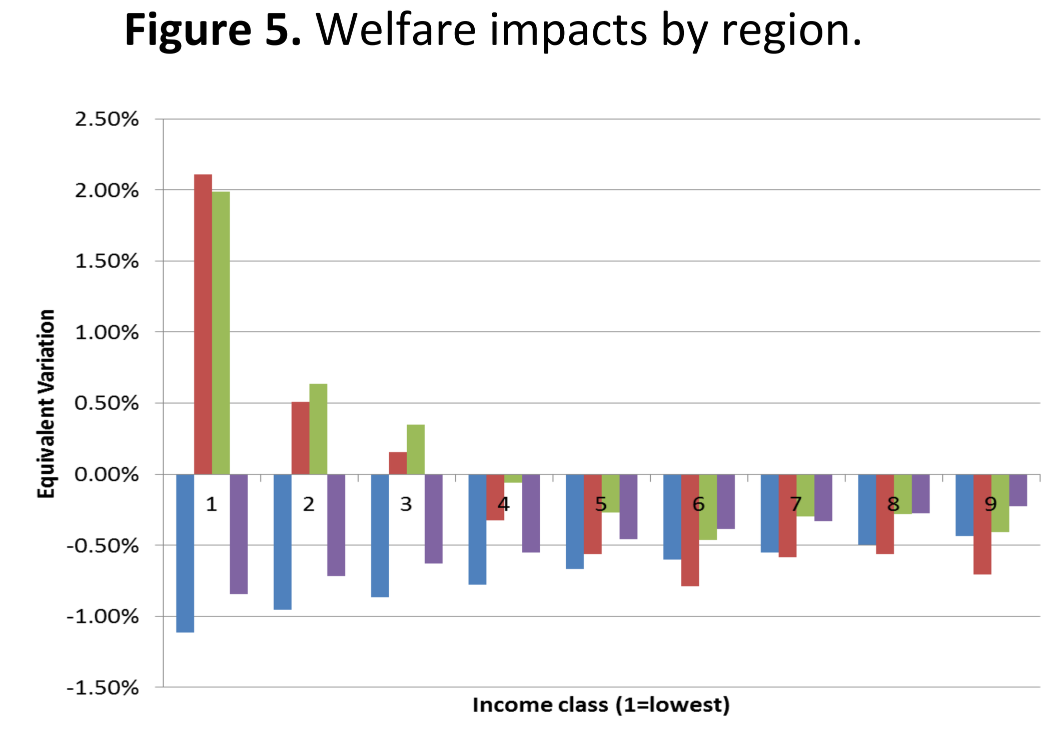

Figure 6. Welfare impacts by income group.

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